A taxonomic revision of *Callitriche* L. (Callitrichaceae) in Australia

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Summary

Bean, A.R. (2007). A taxonomic revision of *Callitriche* L. (Callitrichaceae) in Australia. *Austrobaileya* 7(3): 545–554. A morphological taxonomic study of *Callitriche* L. occurring in Australia (excluding island territories) has resulted in a reduction in the number of accepted indigenous species, with two species being reduced to synonymy (*C. cyclocarpa* Hegelm. under *C. umbonata* Hegelm.; *C. capricorni* R.Mason under *C. sonderi* Hegelm.). The name *Callitriche hamulata* has been misapplied in Australia for *C. brutia* Petagna var. *brutia*. Lectotypes are chosen for *Callitriche brachycarpa* Hegelm., *C. umbonata* Hegelm. and *C. muelleri* Sond. *Callitriche deflexa* A.Braun ex Hegelm. is a recent naturalisation for Australia. All names used for Australian *Callitriche* have been accounted for. A key is provided for the identification of *Callitriche* species occurring in Australia.

Key Words: Callitrichaceae, *Callitriche*, Australia, Australian flora, taxonomy, nomenclature, typification, identification key

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Introduction

Callitriche L. is a genus of about 75 species, found throughout temperate to subtropical parts of the world, mostly in the northern hemisphere. They are delicate herbs, often aquatic or amphibious, sometimes terrestrial, but then always in close proximity to water. The leaves are always opposite, but submerged leaves may differ greatly from emergent ones. All species occurring in Australia are monoecious, with the flowers consisting only of a stamen or a pair of carpels. The fruits comprise four (often winged) mericarps, in two pairs. Their size and shape are often diagnostic for species identification.

Bentham (1864) recorded only one species of *Callitriche* (*C. verna* L.) for Australia. Although taxonomic papers by C.F.Hegelmaier in 1864, 1867 and 1869 resulted in several new species described for Australia, these species were not recognised by Australian botanists until the revision of Mason (1959). Mason recognised all of Hegelmaier's Australian species, and she described an additional new species (*C. capricorni* R.Mason). Treatments by Aston (1973), Orchard (1980) and Jeanes (1999) were all based on Mason's work, with no significant changes.

Accepted for publication 16 April 2007

The current treatment recognises eight species in Australia, four native and four introduced.

Materials and methods

This study is based on morphological examination of herbarium specimens, images of type specimens, and examination of live plants in habitat. Specimens have been examined from the following herbaria: AD, BRI, CANB, HO, MEL, NSW, PERTH, STU. Images of specimens from K have also been seen.

Taxonomy

Callitriche L., *Sp. Pl.* 969 (1753); *Gen. Pl.* ed. 5, 5 (1754). **Type:** *C. palustris* L.

Fragile-stemmed annual or perennial herbs, rooting at the nodes; either fully aquatic, amphibious, or prostrate and terrestrial on damp soil. Plants glabrous or with deciduous peltate scales on leaves and stems. Leaves simple, opposite, entire or nearly so, exstipulate, often dimorphic in aquatic and amphibious plants (narrower when submersed and broader distally, especially when floating or emersed). Petioles present, membranous, sometimes connate. Plants monoecious (usually) or dioecious (not in Australia). Inflorescence axillary, comprising 1 staminate

or 1 pistillate flower, or both together in the same leaf axil, sometimes subtended by a pair of minute, white, inflated bracts. Perianth absent. Staminate flower consisting of a single stamen; anthers 3– or 4–locular, not versatile; filament slender, usually lengthening before and after anthesis. Pistillate flower with 2 carpels; styles 2, terminal, slender, persistent or caducous; ovary superior, syncarpous; ovules 4 (1 per locule), pendulous, anatropous. Fruit somewhat flattened, splitting at maturity into 4 small, nutlike mericarps, these commonly winged along the margins, sometimes wingless, surface smooth or reticulate.

Key to native and naturalised (*) *Callitriche* taxa in Australia

1 Most or all leaves linear, more than 10 times longer than wide 2
Most or all leaves elliptic, spathulate, obovate or orbicular, 1–7 times longer than wide 4

2 Some fruits with pedicels 1–15 mm long; bracts absent . . . . . **5. *C. brutia** var. **brutia**
All fruits ± sessile (pedicels 0–0.5 mm long); bracts present 3

3 Fruit 0.9–1.2 mm broad, and length the same; fruit wing of constant width around mericarp; styles 0.8–1.6 mm long . . . . . **6. C. umbonata**
Fruit 0.7–0.8 mm broad, consistently longer than broad; fruits winged at distal end, but wing tapering to nothing at proximal end; styles 0.2–0.8 mm long . . . . . **7. *C. palustris** var. **palustris**

4 Fruits distinctly broader than long; plants terrestrial 5
Fruit length equal to width, or somewhat longer than wide; plants aquatic or semi-aquatic 8

5 Leaves rhomboidal to orbicular, often with a single tooth on one or both margins; wing of fruit very broad (25–35% of mericarp width) . . . . . **2. C. muelleri**
Leaves spathulate, obovate or elliptic, margins never toothed; wing of fruit 5–20% width of mericarp 6

6 Most fruits pedicellate, pedicels 0.5–4 mm long . . . . . **4. *C. deflexa**
All fruits ± sessile, pedicels 0–0.5 mm long 7

7 Fruits 1–1.2 mm broad; styles 0.8–1.6 mm long . . . . . **1. C. brachycarpa**
Fruits 0.65–0.8 mm broad; styles 0.1–0.3 mm long . . . . . **3. C. sonderi**

8 Fruits consistently longer than wide, width 0.7–0.8 mm; fruits winged at distal end, but wing tapering to nothing at proximal end . . . . . **7. *C. palustris** var. **palustris**
Fruit length virtually equal to width; fruits equally winged on all parts of mericarp, or wing almost lacking 9

9 Some fruits with pedicels 1–15 mm long; bracts absent; styles recurved . . . . . **5. *C. brutia** var. **brutia**
All fruits ± sessile (pedicels 0–0.5 mm long); bracts present; styles erect or spreading 10

10 Lower (submerged) leaves linear; fruits 0.9–1.2 mm long, brown . . . . . **6. C. umbonata**
All leaves spathulate to broadly-obovate; fruits 1.2–1.5 mm long, grey . . . **8. *C. stagnalis**

1. Callitriche brachycarpa Hegelm., *Verh. Bot. Vereins Prov. Brandenburg* 10: 115 (1869). **Type:** Victoria. tributary of the Plenty towards Mt Disappointment, 6 February 1853, *F.Mueller s.n.* (lecto: STU [here chosen]; isolecto: MEL 50296 & 50295).

***Illustration*:** Jeanes (1999: 461).

Terrestrial mat-forming forb. Leaves monomorphic, laminae broadly elliptic to broadly obovate, 2.1–4.1 × 1.4–2.5 mm, entire, apex obtuse; petiole 0.4–1.5 mm long, much shorter than lamina; peltate scales frequent. One staminate and one pistillate flower usually borne in the same leaf axil; bracts absent. Filaments 0.4–1.5 mm long; anthers 0.2–0.3 mm long, yellow. Styles 0.8–1.6 mm long, persistent, not recurved. Fruiting pedicels absent. Mature fruits (including wing) 0.7–0.9 × 1–1.2 mm, not thickened or flared at base, dark brown, surface reticulate; wing absent to very narrow (<10% width of mericarp), evenly surrounding mericarp, cellular divisions not visible.

***Additional specimens examined*: Victoria**. Maits Rest Scenic Reserve, *c.* 6 miles [10km] W of Apollo Bay, Jan 1974, *Beauglehole ACB43987* (MEL); Wilsons Promontory N.P., Dec 1983, *Beauglehole ACB75955* (MEL); Apollo Bay, *s. dat., Mueller s.n.* (MEL). **Tasmania**. Hellyer Gorge, Hellyer River, *c.* 15 metres from east bank of river, Jan 1989, *Davies 1106* (CBG, MEL); 1.33 km north of The Shank, *Moscal 9787* (HO).

***Distribution and habitat*:** *C. brachycarpa* is endemic to Australia. In Victoria, it is known from the Otway Ranges and Wilson's Promontory (and the historical record from just north of Melbourne). It also occurs throughout western Tasmania at low altitudes (**Map 1A**). It grows on damp mud beside creeks and waterholes.

***Phenology*:** Flowers and fruits recorded from December to March.

***Typification*:** In his protologue for *C. brachycarpa*, Hegelmaier mentioned a specimen from Apollo Bay, sent to him by F. Mueller of Australia. The Apollo Bay specimen of *C. brachycarpa* at MEL is consistent with the protologue. However, the specimen at STU, labelled as *C. brachycarpa* and coming from Apollo Bay, does not match the details given in the protologue for *C. brachycarpa*. H. Schotsman determined the latter as *C. umbonata*, and I agree with that determination. Evidently Hegelmaier or a subsequent curator mixed up some of the material that was sent by Mueller. Because of the confusion with the Apollo Bay material, the other syntype at STU (Mt Disappointment) has been chosen as the lectotype.

***Notes*:** *C. brachycarpa* is readily distinguished by its terrestrial habit, short petioles, broader-than-long fruits and very long styles. It is apparently an uncommon species, and is recorded as Vulnerable in Victoria.

2. Callitriche muelleri Sond., *Linnaea* 28: 229 (1856). **Type:** Victoria. Latrobe River, April or May 1853, *F.Mueller s.n.* (lecto [here chosen]: MEL 2289178, ex herb. Sonder; isolecto: K 000348666, MEL 2289180 & 2289179A).

Callitriche macropteryx Hegelm., *Monogr. Callitriche* 59 (1864). **Type:** New South Wales. Hawkesbury River, 1802–1804, *F.Bauer s.n.* (syn: ?W; *n.v., fide* Mason (1959)).

***Illustrations*:** Jeanes (1999: 461); Aston (1973: 55).

Terrestrial mat-forming forb. Leaves monomorphic, laminae orbicular to rhomboidal, 1.4–2.9 × 1.4–3.3 mm, entire or with a tooth on one or both margins, apex obtuse; petiole 1.7–3.1 mm long, as long as or slightly shorter than lamina; peltate scales absent. One staminate and one pistillate flower usually borne in the same leaf axil, bracts absent. Filaments 0.1–0.2 mm long; anthers 0.1–0.15 mm long, yellow. Styles 0.1–0.2 mm long, persistent, not recurved. Fruiting pedicels absent. Mature fruits (including wing) 1–1.3 × 1.2–1.4 mm, rarely thickened or flared at base, pale to dark brown, surface reticulate; wing very broad (25–35% width of mericarp), evenly surrounding mericarp or broader towards apex, cellular divisions often visible.

***Additional specimens examined*: Queensland.** Cook District: S.F.185 Danbulla, 1.7 km down Kauri Creek road, Jul 1994, *Forster PIF15606 et al.* (BRI, MEL). Leichhardt District: Mickey's Creek, Carnarvon Gorge, Mar 2001, *Fensham 4798* (BRI). Wide Bay District: Corella Creek, S.F. 700, N of Gympie, Oct 1993, *Bean 6705* (BRI). Moreton District: Brisbane

Forest Park, Enoggera Creek, Apr 1993, *Halford Q1674* (BRI); Kiamba *c.* 6 km W of Nambour, Jun 1990, *Sharpe 4950 & Bean* (BRI). **New South Wales.** Kioloa S.F., NE of Batemans Bay, Oct 1966, *Adams 1589* (CANB); near Brummies Lookout, SE of Tyalgum, Jan 1999, *Bean 14561* (BRI, MEL, NSW); base of Mt Killiekrankie, Oakes S.F., WSW of Bellingen, Jan 1999, *Bean 14596* (BRI); Couria Creek, Mt Dromedary, Jan 1970, *Burbidge 7817* (CANB); **Victoria.** Coranderrk Bushland Reserve, *c.* 4.5 km S of Healesville, Jan 1980, *Willis s.n.* (MEL); Lilly Pilly Gully, NE of Tidal River camp, Dec 1975, *Aston 1891* (CANB, MEL); Mallacoota Inlet N.P., Villarsia Creek, Dec 1969, *Beauglehole 32906* (MEL); Wallagaraugh River, *c.* 1 km downstream from Gipsy Point settlement, Oct 1991, *Walsh 3138* (MEL).

***Distribution and habitat*:** An indigenous species for Australia. *C. muelleri* is distributed more or less continuously in near-coastal areas from southern Queensland to western Victoria. Disjunct occurrences in Queensland include the Atherton Tableland and Carnarvon Gorge (**Map 1D**). It is also native in New Zealand, but strangely absent from Tasmania. It occurs on damp shady sites in rainforest or dense eucalypt forest.

***Phenology*:** Flowers and fruits throughout the year.

***Typification*:** There are Mueller specimens of *C. muelleri* labelled 'Latrobe River' at both MEL and K. The MEL sheet 2289178 is chosen as the lectotype, as it has the note "ex herbarium Sonder", and hence is the only sheet that was definitely seen by Sonder when drawing up his species description.

The type of *C. macropteryx* was not received on loan. However, its identity is clear. Hegelmaier soon reduced his *C. macropteryx* to synonymy with *C. muelleri* (Mason 1959), and so he clearly considered them conspecific. The large wing of the fruit, alluded to by the epithet *macropteryx*, is a diagnostic feature for *C. muelleri*.

***Notes*:** A very distinctive species because of its bright green, ± orbicular leaves and its broadly winged fruit.

3. Callitriche sonderi Hegelm., *Verh. Bot. Vereins Prov. Brandenburg* 9: 18 (1867). **Type:** Victoria. Station Peak [between Melbourne and Geelong], Australia Felix, *s. dat.*, *F.Mueller s.n.* (holo: STU; iso: MEL [2289177]).

Callitriche capricorni R.Mason, *Austral. J. Bot.* 7: 307 (1959), ***syn. nov.*** **Type:** Queensland. [Moreton District] Brisbane River, July 1874, *F.M.Bailey s.n.* (holo: BRI).

***Illustration*:** Jeanes (1999: 461)

Terrestrial mat-forming forb. Leaves monomorphic, laminae spathulate to narrowly-obovate, 1.4–3.7 × 0.4–2.1 mm, entire, apex obtuse; petiole 0.3–0.8 mm long, much shorter than lamina; peltate scales present. One staminate and one pistillate flower usually borne in the same leaf axil; bracts present, 0.2–0.4 mm long. Filaments 0.2–0.4 mm long; anthers 0.1–0.15 mm long, yellow. Styles 0.1–0.3 mm long, not recurved. Fruiting pedicels absent. Mature fruits (including wing) 0.5–0.6 (–0.7) × 0.65–0.8 mm, sometimes thickened or flared at base, dark brown to black, surface reticulate; wing 5–10 (–20)% width of mericarp, evenly surrounding mericarp, cellular divisions not visible.

***Additional specimens examined*:** **South Australia**. River Murray, *c.* 1 km N of Murtho Park homestead, Sep 1979, *Barker 3978 & Barker* (AD, MEL); Cunnabuncha Waterhole on Strzelecki Creek, *c.* 15 km N of Merty Merty, Jul 1997, *Purdie 4484* (CANB). **Queensland.** Port Curtis District: margins of Lake Victoria, S of Dululu, Sep 1999, *Bean 15410* (BRI). Leichhardt District: Rolleston, backwash of the Comet River, Sep 1983, *Aston 2477* (AD, BRI, HO, MEL). Maranoa District: 5 km W of Mungallala, May 2002, *Bean 19022* (BRI). Warrego District: 56 km SSW of Eulo, 1973, *Pike s.n.* (BRI [AQ13188]). **New South Wales.** Montague Island, *c.* 9 km ESE of Narooma, Apr 1973, *Adams 3172* (CANB); Woomargama N.P., Spring Creek, *c.* 10.3 km S of Woomargama, Nov 2001, *Crawford 6819* (CANB); 'Bundycoola', Cobar, Aug 1974, *Cunningham 853* (NSW); 4km SE of 'Mt Mulyah' homestead, about 60 km NW of Louth, Sep 1978, *Moore 7921* (CANB). **Victoria.** Nip Nip, Hattah Lakes N.P., Sep 1969, *Anderson s.n.* (MEL); Hattah-Kulkyne N.P., Chalka Creek S of Lake Lockie, Oct 1982, *Cheal s.n.* (MEL); Tallangatta, May 1972, *Lumley 6* (MEL); Melton Reservoir, immediately on the N side of Ballarat railway line, May 2003, *Stajsic 3338 & Wlodarczyk* (MEL). **Tasmania**. Sea Elephant River, King Island, Jan 1979, *Morris 7950* (MEL).

***Distribution and habitat*:** *C. sonderi* is endemic to Australia. It is widespread in southern Queensland, much of New South Wales and Victoria, and in South Australia as far west as Coober Pedy. It is also known from King Island in Tasmania (**Map 1F**). It grows on damp soil adjacent to rivers, creeks and waterholes.

***Phenology*:** It flowers and fruits from April to October in the northern part of range, and throughout the year in the southern part of range.

***Typification*:** A single specimen of *C. sonderi* collected by Mueller exists at STU, and another is at MEL. Both are labelled 'Station Peak'. Hence, the STU specimen may be designated holotype.

***Note*:** It is not possible to maintain *C. capricorni* as a distinct taxon. Mason (1959) distinguished it from *C. sonderi* by the fruits. She said that *C. capricorni* has non-umbonate mericarps and a very wide commisural groove, and that *C. sonderi* has umbonate mericarps and a narrow commisural groove. However, a wide range of variation occurs in the fruits of *C. sonderi,* and the capricorni-type fruit is merely one form of that variation. Fruit morphology does not appear to be correlated to other characters or to geography.

4. *Callitriche deflexa A.Braun ex Hegelm., *Monogr. Callitriche* 58, t. 3 (1864). **Type:** Brazil. Rio de Janeiro, 1859–60, *F.Rudio,* ex herb. A. Braun (syn: CM, GH, MO; *fide* Lansdown (2006a: 115)).

[*C. marginata* in J.H. Ross & N.G.Walsh, *A Census of the Vascular Plants of Victoria*, Seventh Edition (2003).]

Terrestrial mat-forming forb. Leaves monomorphic, laminae spathulate to elliptic, 1.3–3 mm × 0.5–1.6 mm, entire, apex obtuse; petiole 0.5–2 mm long, shorter than lamina; peltate scales present. One staminate and one pistillate flower usually borne in the same leaf axil, bracts absent. Filaments 0.3–0.5 mm long; anthers 0.1–0.15 mm long, yellow. Styles 0.2–0.8 mm long, recurved. Fruiting pedicels 0.5–3 mm long. Mature fruits (including wing) 0.5–0.7 × 0.7–0.9 mm, not thickened or flared at base, dark brown to black, surface reticulate; wing very narrow (<10% width of mericarp), evenly surrounding mericarp, cellular divisions not visible.

***Specimens examined*: Victoria.** Nursery/glasshouse site, Royal Botanic Gardens, Melbourne, Jul 2000, *Stajsic 2963* (MEL); NW end of the Ornamental Lake, Royal Botanic Gardens, Melbourne, Nov 2002, *Stajsic 3319* (MEL); western bank of Long Island, Royal Botanic Gardens, Melbourne, Sep 2001, *Walsh 5392* (CANB, MEL).

***Distribution and habitat*:** *C. deflexa* is currently known only from the Melbourne Botanic Gardens at South Yarra (**Map. 1C**), where it grows on mud beside lakes, and along shaded paths, in cracks between paving bricks. Naturalised occurrences are also known from Portugal, Morocco, Tanzania and South Africa (R. Lansdown pers. comm.). It is native to the east coast of South America, and a few places in central America.

***Phenology*:** This species appears to flower and fruit throughout the year.

***Notes*:** *C. deflexa* closely resembles *C. sonderi*, but differs from it by the absence of bracts, the distinctly pedicellate fruits and the longer styles.

5. *Callitriche brutia Petagna, *Inst. Bot.* 2: 10 (1787). **Type:** Italy. Calabria. ex herb. Petagna (lecto: FI; *n.v., fide* Schotsman (1967: 85)).

[*C. hamulata auct. non* Kütz. in W.D.J.Koch: Mason (1959: 323); Aston (1973: 53).]

***Illustrations*:** Jeanes (1999: 461); Aston (1973: 55), both as *C. hamulata.*

Aquatic forb. Leaves dimorphic, lower leaves evenly spaced, linear, 7–23 mm × 0.4–0.8 mm, entire, apex deeply notched, petiole absent; upper leaves clustered, spathulate to obovate, 4–7 × 0.6–3.4 mm, apex obtuse or emarginate, petioles present, intermediate leaf forms common; peltate scales present. Staminate and pistillate flowers borne in different leaf axils, bracts absent. Filaments 0.2–1 mm long; anthers *c.* 0.1 mm long, translucent or white. Styles 0.3–0.9 mm long, recurved. Fruiting pedicels 0.5–15 mm long. Mature fruits (including wing) 0.9–1.2 × 0.8–1.2 mm, not thickened or flared at base, pale to dark brown, surface smooth or reticulate; wing absent or very narrow (<10% width of mericarp), evenly surrounding mericarp, cellular divisions not visible.

***Additional specimens examined*: Western Australia.** Benger, 90 miles [145 km] S of Perth, Oct 1963, *Hitchcock s.n.* (CANB); Tuart forest, SW of Ludlow, Sep 1994, *Keighery 13373* (PERTH); 1 km south-west of Capel, Sep 1988, *Keighery 10470* (PERTH). **South Australia.** Comaum, *Alcock 5* (AD). **New South Wales.** western Wanganella Swamps, in travelling stock reserve, Sep 1990, *Roberts 671* (CANB). **Victoria.** *c.* 15 miles [24 km] WNW of Ararat, 3 miles [5km] SE of Pomonal,

Nov 1965, *Aston 1408* (MEL); Winton Swamp, 9 miles [14 km] ENE of Benalla, Sep 1960, *Aston 621* (MEL); Gunbower Forest, north of the Koondrook Track, Oct 1981, *Scarlett 18-140* (MEL); Baddaginnie district, Aug 1988, *Strudwick JES0012* (MEL); Linton, 1912, *Williamson 1499* (MEL). Tasmania. Houfes nad, King Island, Oct 1998, *Woolley & Askey-Doran s.n.* (HO).

***Distribution and habitat*:** *C. brutia* var. *brutia* is naturalised in Australia, especially in Victoria, but also in adjacent parts of New South Wales and South Australia, and in the south-west of Western Australia (**Map 1B**). It grows in shallow water, in drains, creeks and dams. It is also naturalised in New Zealand. It has a wide native distribution, including Europe, Greenland, Morocco, Iran and the Caucasus.

***Phenology*:** Flowers and fruits throughout the year.

***Notes*:** This taxon has been called *C. hamulata* in Australia since the revision of Mason (1959). Lansdown (2006a) recently reduced *C. hamulata* to a variety of *C. brutia*. However, it is the typical variety that is found in Australia. The first specimen record for Australia was that collected in 1912 from Linton, Victoria.

6. Callitriche umbonata Hegelm., *Verh. Bot. Vereins Prov. Brandenburg* 9: 19 (1867). **Type:** Tasmania. South Esk, 1848–1857, *C.Stuart s.n.* (lecto: STU [here chosen]; isolecto MEL 2289182B & 2289185).

Callitriche cyclocarpa Hegelm., *Verh. Bot. Vereins Prov. Brandenburg* 10: 116 (1869), ***syn. nov.*** **Type:** Victoria. Yarra Yarra, *s. dat., F.Mueller s.n.* (holo: STU; iso: MEL 224504).

***Illustration*:** Jeanes (1999: 461)

Aquatic or amphibious forb. Leaves dimorphic, lower leaves evenly spaced, linear, 3.5–6 × 0.2–0.6 mm, apex obtuse or emarginate, petiole absent; upper leaves clustered or evenly spaced, spathulate to elliptical, 2.5–6 × 1.8–3 mm, apex obtuse, petioles present, shorter or longer than lamina, intermediate leaf forms occurring; peltate scales present. Staminate and pistillate flowers usually borne in same leaf axils; bracts present, 0.6–1 mm long. Filaments 0.2–1.6 mm long; anthers 0.1 mm long, white. Styles 0.8–1.9 mm long, not recurved. Fruiting pedicels absent. Mature fruits (including wing) 0.9–1.2 × 0.9–1.2 mm, slightly thickened at base and sometimes umbonate, pale to dark brown, surface reticulate; wing 10–20% width of mericarp, evenly surrounding mericarp, cellular divisions sometimes visible.

***Additional specimens examined*: South Australia.** Mt Monster Conservation Park, *Murfet 2060 & Taplin* (AD). **New South Wales.** Macquarie Marshes 20 km NW of 'Sandy Camp', Aug 1979, *Paijmans 3175* (CANB); Western Wanganella Swamps, Sep 1990, *Roberts 671* (CANB); Cooleman Plain, just below Cooleman Range, 17 miles [28.3 km] NNE of Kiandra, Dec 1969, *Rodd & Coveny 2682* (NSW). **Victoria.** Hawkesdale, Nov 1903, *Williamson s.n.* (MEL); Glenorchy, 12 miles [20 km] NW of Stawell, Sep 1960, *Beauglehole ACB6772* (MEL); Mitre Rock, N of Mt Arapiles, Nov 1968, *Beauglehole ACB29880* (MEL). **Tasmania.** Jericho, Midlands Highway, Oct 1970, *Morris s.n.* (HO).

***Distribution and habitat*:** *C. umbonata* is endemic to Australia. It is of scattered occurrence in New South Wales, Victoria, the south-east of South Australia, and Tasmania (**Map 1H**), in rock pools, shallow streams or billabongs.

***Phenology*:** Flowers and fruits are borne from August to December.

***Typification*:** In the protologue for *C. umbonata*, Hegelmaier cited three specimens/locations – "Tasmania, Stuart; in stagnant pools near Melbourne, Nov 1852, Mueller; Darebin Creek, Mueller". Mason (1959) referred to the presence of a 'Darebin Creek' syntype at STU, but specimens loaned from STU included no such specimen. Two *C. umbonata* specimens were received from STU. One is labelled "in stagnant pools near Melbourne", but the specimen is tiny and is obviously just a small fragment of the original material that Mueller would have sent. The second specimen is of good size and matches the protologue well. It is labelled "South Esk, Tasmania", and was undoubtedly collected by Charles Stuart, as determined by Mason (1959). This latter specimen is chosen as the lectotype.

***Notes*:** The fruits on the type specimen of *C. cyclocarpa* are smaller and with a narrower wing than those commonly attributed to *C. umbonata*. However, a small proportion of the fruits on the *C. umbonata* type material are a very good match for those on the *C. cyclocarpa* type. I contend that the

fruits of the *C. cyclocarpa* type specimen are merely immature, and that the specimen represents *C. umbonata*. No other character separates *C. cyclocarpa* from *C. umbonata*. Significantly, when Hegelmaier described *C. cyclocarpa*, he compared it with *C. verna*, *C. muelleri*, *C. stagnalis* and *C. hamulata*, but not with *C. umbonata*.

C. umbonata is a poorly collected species, and may be easily confused with *C. brutia* var. *brutia*.

7. *Callitriche palustris L., *Sp. Pl.* 2: 969 (1753). **Type:** the three lower specimens, Herb. Linn. No. 13.1 (lecto: LINN; *fide* Lansdown & Jarvis (2004: 169)).

Callitriche verna L., *Fl. Suec.*, ed. 2: 2 (1755). **Type:** Herb. Linn. No. 13.2 (lecto: LINN; *fide* Lansdown & Jarvis (2004: 171)).

***Illustration*:** Jeanes (1999: 461)

Aquatic or amphibious forb. Leaves dimorphic; lower leaves evenly spaced, narrowly-elliptic to linear, 3–4.5 × 0.3–0.7 mm, entire, apex obtuse or emarginate, petiole absent; upper leaves clustered or evenly spaced, spathulate to broadly-elliptic, 2.2–5 × 0.9–2 mm, apex obtuse, petioles present, shorter or longer than lamina, intermediate leaf forms occurring; peltate scales present. Staminate and pistillate flowers usually borne in same leaf axils; bracts present, 0.4–0.6 mm long. Filaments 0.2–0.4 mm long; anthers *c.* 0.2 mm long, white. Styles 0.2–0.8 mm long, not recurved. Fruiting pedicels absent. Mature fruits (including wing) 0.8–1 × 0.7–0.8 mm, not thickened or flared at base, brown, surface reticulate; wing 10–20% width of mericarp, present only along distal half, cellular divisions sometimes visible.

***Additional specimens examined*: Victoria.** Mt Pinnibar Hut area, 6.5 miles [10.8 km] direct north of Mt Gibbs, Feb 1973, *Beauglehole ACB41596 & Rogers* (MEL); Biggara, Nov 1928, *Williamson s.n.* (MEL); South Bryce Plain, Snowy Range, Nov 1980, *Walsh 971* (MEL); Cobbaras Mts, playground under S side of Cobbaras, Feb 1974, *Willis s.n.* (MEL).

***Distribution and habitat*:** *C. palustris* is naturalised in Australia, and confined to eastern Victoria (and probably adjacent New South Wales), often at altitudes exceeding 1000 metres (**Map 1E**). This very widespread taxon is native in Europe, temperate Asia, and much of North America. It grows in shallow water e.g. drains, ponds, dams.

***Phenology*:** Flowers and fruits recorded from November to February.

***Notes*:** According to the key provided in Lansdown (2006b), the taxon occurring in Australia is *C. palustris* var. *palustris*.

Specimen citations by Mason (1959) suggest that the first Australian record was in 1874 from "lower Hume's [=Murray] River", on the Victoria-New South Wales border. I have not seen that specimen.

Specimens lacking mature fruits may be difficult to distinguish from *C. umbonata*.

8. *Callitriche stagnalis Scop., *Fl. Carniol.* ed. 2, 2: 251 (1772). **Type:** United Kingdom (Wales). Aberleri Fields, Borth, 20 July 1998, *A.O.Chater s.n.* (neo: NMW; *fide* Lansdown (2006a: 108)).

***Illustrations*:** Jeanes (1999: 461); Aston (1973: 58).

Aquatic or amphibious forb. Leaves monomorphic, sometimes clustered near apex; laminae spathulate to broadly-obovate, 2.6–7 × 1.5–5.1 mm, entire, apex obtuse; petiole 1.2–4.2 mm long, usually shorter than lamina; peltate scales present. Staminate and pistillate flowers borne in the same or separate leaf axils; bracts present, 0.3–0.9 mm long. Filaments 0.7–2.5 mm long; anthers 0.15–0.3 mm long, yellow. Styles 0.5–2.3 mm long, persistent, not recurved. Fruiting pedicels absent. Mature fruits (including wing) 1.2–1.5 × 1.2–1.5 mm, occasionally rarely flared at base, grey, surface smooth; wing moderate (10–20% width of mericarp), evenly surrounding mericarp, cellular divisions not visible. *Common water-starwort*.

Additional specimens examined: **Western Australia.** Kenwick, south of Perth, Nov 1993, *Jacobs 6949* (MEL); 1.8 km S of Willyung–Parkerbrook Road, on Rocky Crossing Road, *c.* 7.5 km NW of Albany, Nov 1995, *Lepschi & Lally 2367* (CANB, MEL, PERTH). **South Australia.** Brockhoffs, Nov 1991, *Bates 26233* (AD, MEL); Mount Lofty Ranges, Stirling West, near Mount Lofty, Jan 1957, *Ising s.n.* (MEL); 3 km north of Yundi, 55 km S of Adelaide, Sep 1957, *Schodde 498* (CANB). **Queensland.** Leichhardt District: Crystalbrook, NW of Injune, Oct 1999, *Fensham 3854*

(BRI). Wide Bay District: adjacent to Witta cemetery, N of Maleny, Oct 2000, *Bean 16914* (BRI). **New South Wales.** 3.4 km along Majors Point road, NE of Ebor, Feb 2001, *Bean 17350* (BRI, NSW); Rocky River, 35 km NE of Glen Innes via Gwydir Highway, Aug 1987, *Hind 5254 & D'Aubert* (MEL, NSW); banks of Namoi River, Warrabah N.P., Sep 1994, *Hosking 994* (CANB); Wingecarribee Swamp, *c.* 2.5 km NE of Burrawang, *c.* 4.5 km due WNW of Robertson, Sep 1992, *Kodela 188* (CANB); Bondo S.F., Dubbo Creek *c.* 7 km S along Broken Cart Fire Trail, Feb 1999, *Taws 925* (CANB). **Australian Capital Territory.** Black Mountain slopes, Australian National Botanic Gardens, Oct 1985, *Ward 157* (CBG). **Victoria.** *c.* 4 miles [6 km] WSW of Stawell, on road to Halls Gap, Nov 1965, *Aston 1411* (MEL); Orbost Rifle Range area, Orbost, Nov 1970, *Beauglehole ACB34514* (MEL); Splitters Range Forest Block, 6 km SSW of Mount Tambo, Dec 1984, *Carr 10189* (MEL); Boundary Creek, Wulgulmerang, Nov 1962, *Willis s.n.* (MEL). **Tasmania.** drainage ditch, corner Montagu Road and Bolduans Road, Nov 2004, *Duretto 1811* (CANB); Melaleuca, Apr 1992, *Jacobs 6465* (HO, MEL, NSW); Henty Bridge on Strahan – Zeehan road, Dec 1981, *Orchard 5744* (CANB).

***Distribution and habitat*:** *C. stagnalis* is widely naturalised in Australia, occurring in south-east Queensland, eastern New South Wales, much of Victoria and Tasmania, south-eastern South Australia and south-western Western Australia (**Map 1G**). It is also naturalised in New Zealand and North America. It has a broad native distribution in Europe and western Asia. It grows in the shallow water of drains, pools and creeks, and sometimes in mud where water has receded.

***Phenology*:** Flowers and fruits throughout the year.

***Note*:** The first Australian specimen records were in 1881 (Sydney area) and 1882 (near Adelaide). It is now the most widespread and abundant alien *Callitriche* species in Australia.

Excluded Names

Callitriche antarctica Hegelm., *Verh. Bot. Vereins Prov. Brandenburg* 10: 115 (1869). **Type:** Antarctic Archipelago, *J.D.Hooker s.n.* (syn: *n.v.*); Kerguelen Island, May–July 1840, *J.D.Hooker* (syn: *n.v.*); Campbell Island, Dec. 1840, *J.D.Hooker* (syn: NSW).

Mason (1959) reported a specimen citation by Fassett in 'Callitriche of the New World' (1951), recording *C. antarctica* for Tasmania, supposedly collected by Gunn. No further records have been forthcoming and it seems highly likely that this citation is erroneous, and that the species is absent from Australia, excluding island territories, already documented by Orchard (1993).

Callitriche platycarpa Kütz. in Reichenb., *Ic. Plant. Crit.* cent. ix: 38 (1831). **Type:** Magdeburg, Germany, received 1865, *W.F.R.Suringar* (lecto: L; *fide* Lansdown (2006a: 109)).

Hooker (1859) referred to this species occurring on the Antarctic Islands. However, the only species known from these islands is *C. antarctica.*

Acknowledgements

A grant by the Australian Biological Resources Study (ABRS) provided the opportunity to examine the taxonomy and nomenclature of the Australian *Callitriche*. I thank Val Stajsic and Neville Walsh (both MEL) for their advice and assistance; Juliet Wege (Australian Botanical Liaison Officer 2005–06) for providing images of type material of *C. muelleri* and *C. umbonata*; and the Directors of AD, CANB, HO, MEL, NSW, PERTH and STU for the loan of specimens. Above all, I am indebted to Richard Lansdown (U.K.) who provided reprints of relevant publications (including those of Hegelmaier), and whose generous assistance on a wide range of callitrichous matters was promptly given on numerous occasions.

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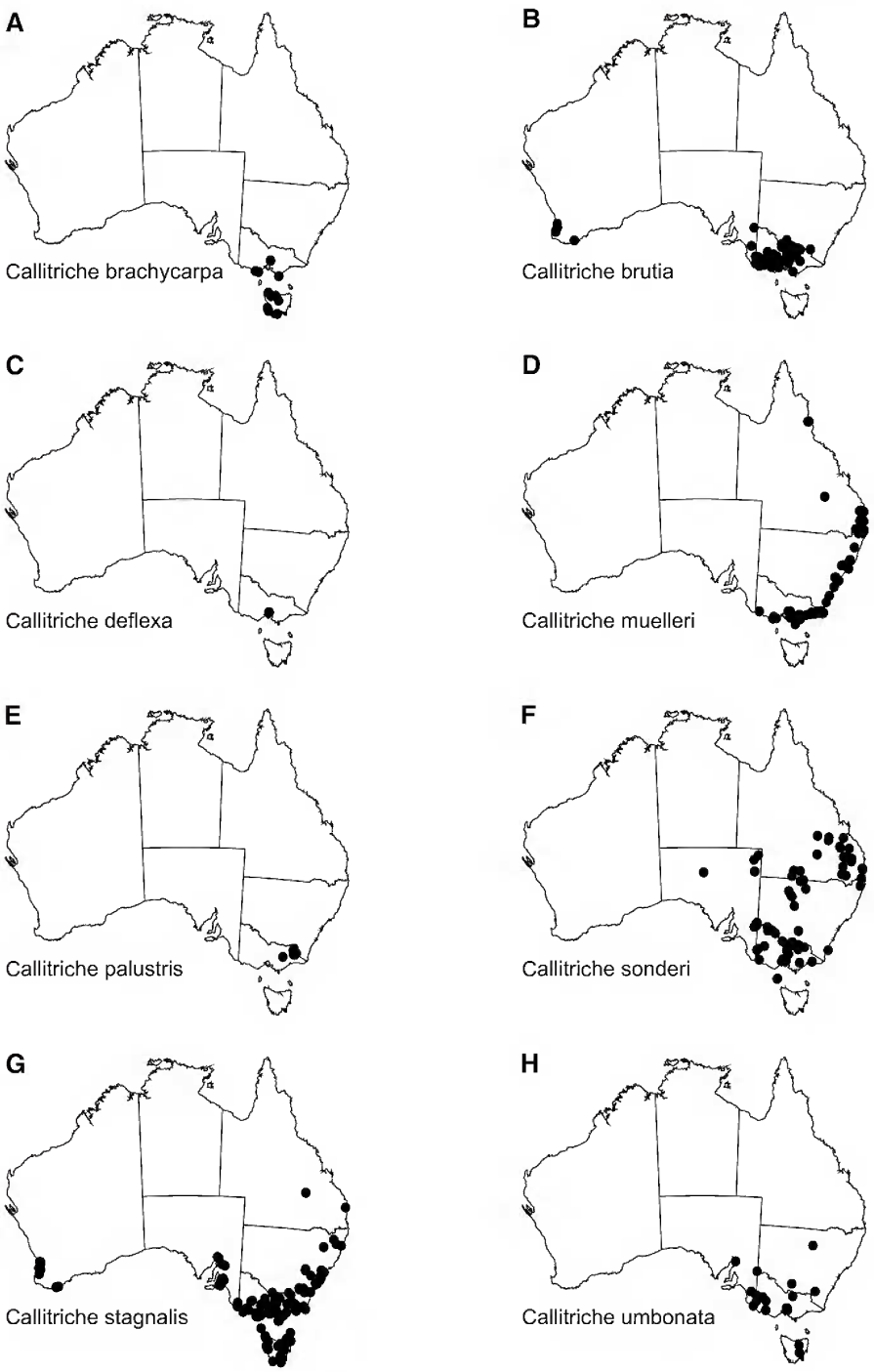

Map 1. Distribution of *Callitriche* spp. in Australia